CALCULATION SHEET

Calculation No.: 1			**Revision No.:** 0
Subject: Emission Control System for Shingle Processing Unit, Fiberglass polish and oil tanks C6 Zero Iowa Facility			
Originator: T. Struttmann	**Date:** 09-02-21	**Checker:** C. Tackett	**Date:** 09-03-21

Calculation Sheet

1.0 PURPOSE

Background:
A patented technology to separate asphalt shingles into their base component pieces on a project at the C6 Zero facility in Merango, Iowa. The intermediate processing facility receives discarded asphalt shingles meeting their specification for processing. The process uses a patented solvent with patented mechanical equipment to dissolve the asphaltenes (long chain hydrocarbons C14 to C20) in the shingles and separate the oil, fiberglass, and sand into recycled commercial products. The chemical bonding (ionic bond) between the solvent and the asphalt shingle form an oil. This oil has a lower evaporative potential than the solvent alone and thus emissions from the process are minimized.

The air permit and emission calculations were performed by others. This calculation is to size the appropriate vapor phase controls to meet the 85% vapor removal from key process units to meet the air permit exemption.

The overall process includes six process steps including:

- Shingle loading
- Shingle processing unit
- Fiberglass polishing, wash, and fiber shredder
- Sand polishing
- Oil/Water Separator
- Oil storage and loading

The shingle processing unit uses no heat or friction and the process requires no domestic water or sanitary sewer connection.

Air emission sources are regulated by the Iowa Department of Natural Resources (IDNR) air quality regulations. Pursuant to these regulations, unless covered by an exemption specified in 567 Iowa Administrative Code (IAC) 22.1(2), stationary air pollutant emitting equipment is required to obtain an air construction permit prior to construction or modification. However, there is a Small Unit Exemption promulgated under 567 IAC 22.1(2)(w). Under this exemption, emission units and associated control equipment that emit less than the applicable small unit emission thresholds are not required to obtain a construction permit. For VOCs, the small unit emission threshold is 5 tons per year on a rolling 12-month basis. Facilities claiming a small unit exemption are not required to notify IDNR unless an emission unit exceeds the substantial small unit threshold. For VOCs, this threshold is 3.75 tpy on a rolling 12-month basis. As presented in the air permit application, VOC emissions from the emission units associated with the Facility qualify for the small unit exemption with potential emissions less than

the substantial small unit threshold. As such a construction permit and agency notification are not required.

These calculations were prepared to support the air permit application demonstrating that the appropriate air pollution equipment is sized properly and can attain the 85% removal in the permit.

Calculation Objectives:
The objectives of this calculation are to design an emission control system on the shingle processing unit, fiberglass polishing unit and oil storage tanks.

2.0 REFERENCES

Existing system information obtained from the following sources:

1. Certificate of Analysis for Kaniksu-2 "C6-Zero Chemical-CDHDRL": 61.45° API at 60°F, 7/1/2021 from Texas Oil Tech Laboratories, L.P.
2. Carbon Mass Loading on Granular Activated Carbon (GAC), 9/23/20 Email from Donna Cummings at General Carbon Corporation
3. Blower Specifications, Howden American Fan Company Technical Data Sheet AFR – Radial Bladed, 2015
4. GAC Vessel Specifications, General Carbon Corporation Vapor Box Adsorbers

3.0 DESIGN INPUT

The permit application proposed the following parameters for the equipment identified as requiring air pollution control (i.e. shingle processing unit, fiberglass polish unit and 4 finished oil storage tanks):

1. Control emissions of up to 237 lb Volatile Organic Compounds (VOC)/day.
2. The VOC contributions from the source materials (noted as the uncontrolled emission rates) are included in the table below:

PROCESS UNIT	Uncontrolled VOC		Overall Control Efficiency (%)	Controlled VOC	
	lb/yr	tpy		lb/yr	tpy
Shingle Processing Unit	46,995	23.50	85%	7,049	3.52
Fiberglass Polish	23,200	11.60	85%	3,480	1.74
Oil Storage #1[/B]	4,059	2.03	85%	609	0.30
Oil Storage #2[/B]	4,059	2.03	85%	609	0.30
Oil Storage #3[/B]	4,059	2.03	85%	609	0.30
Oil Storage #4[/B]	4,059	2.03	85%	609	0.30
Total (lb/yr)	86,430	43		12,964	6
Total (lbs/day)	**237**			**36**	

3. The carbon system will need to achieve a control efficiency of 85% (for VOCs), resulting in post-control emission rates of <36 lb/day VOC.
4. Carbon beds were identified in the application.

4.0 ASSUMPTIONS

Design Constraints

- Average Face Velocity is 200 ft/min based on the air permit and emission calculations.
- Relative humidity <50% desired for carbon load efficiency
- Carbon bed velocity (30 – 70 ft per min) General Carbon Corporation Bed Deign

5.0 ANALYTICAL METHODS AND COMPUTATIONS

1. Calculate total air flow rate for the system.
    a. This is performed by summing the areas that have the potential for emissions for the 3 process components: shingle processing unit, fiberglass polish unit and oil storage tanks.
    b. Using these areas, determine the total flow necessary to meet 200 LFPM for those openings to capture of all potential vapors from the units.
2. Determine the daily mass loading on the carbon beds. These mass loading calculations were determined by others in the analysis of the overall system process. The daily loading aids in bed sizing
3. Determine the inlet VOC concentrations based on the flow rate and mass loading
4. Select Size Carbon Units
    Calculate Flow for Carbon Beds based on acceptable bed velocity.
    Mass Loading
5. Designing the inlet
    Size the blower
        Delta P across the carbon beds
        Line Loss

6.0 RESULTS

The emissions control system will include:

- A vapor control structure over the shingle processing unit, fiberglass polish unit, and 4 oil tanks will be constructed of sheet metal with an equivalent duct diameter of 12".
- A Howden American Fan Company Backward Curved BSC-150 with a rated operating point of 1800 cfm at 10" W.C.
- Three General Carbon Corporation VB-5000 vapor box adsorbers with granular activated carbon.

This system meets the target of 85% removal of 237 lb/day of VOCs.

ATTACHMENT SHEET

Calculation No.:			**Revision No.:** 0
Subject: Emission Control System for Shingle Processing Unit, Fiberglass polish and oil tanks C6 Zero Iowa Facility			
Originator: T. Struttmann	**Date:** 09-2-21	**Checker:** C. Tackett	**Date:** 09-03-21

Design Calculations

Figure 1. Process Flow Diagram

Other Attachments:

- Certificate of Analysis for Kaniksu-2 “C6-Zero Chemical-CDHDRL”
- Howden American Fan Company Technical Data Sheet
- General Carbon Corporation Vapor Box Adsorbers Technical Data Sheet
- Internal Memo for Control and Operations Sequence for Air Pollution Control Equipment

Calculate Open areas for individual process units to size carbon treatment syste

Input
Output

Equations

Area rectangle $A=L*w$

Area pipe annulus $A=\pi (D_1^{\ 2}-D_2^{\ 2})/4$

Process unit	Opening	L (in)	W (in)	area (ft^2)	Outer pipe D_1 (in)	Inner pipe D_2(in)	Open annulus (in^2)	Area (ft^2)	Comments
Shingle processing unit	Inlet	12	48	4.0					design open area based on construction drawing
	Outlet oily sand	6	6	0.25					fully enclosed. Area represents allocation for connections
	outlet fiberglass	6	6	0.25					fully enclosed. Area represents allocation for connections
fiberglass polishing unit	Inlet	6	6	0.25					fully enclosed. Area represents allocation for connections
	Outlet	6	6	0.25					fully enclosed. Area represents allocation for connections
Sand Screw #1	inlet	0	0	0.0	10	8	28	0.20	tube in tube. Area based on nominal gap between 8 inch pipe into 10 inch hole
	outlet			0.0	0	0	0	0.00	discharge into shaker table below water level
Oil storage tank 1					6	0	28	0.20	
Oil storage tank 2					6	0	28	0.20	
Oil storage tank 3					6	0	28	0.20	
Oil storage tank 4					6	0	28	0.20	
				5.0				0.98	

total open area (Ft2)	6.0	ft^2

Calculate the flow rate for the blower

Velocity	V	200	FPM	Design face velocity for open areas to ensure no emissions at 200 FPM
Area	A	6.0	ft^2	
Flow	Q	1196	CFM	
Safety factor		1.5		
Design flow	Q	1794	CFM	

Calculate VOC Mass Loading of Carbon for components with vapor phase controls

Input
Output

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	lb/yr	tpy		lb/yr	tpy
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Oil Storage #3/B	4,059	2.03	85%	609	0.30
Oil Storage #4/B	4,059	2.03	85%	609	0.30
TOTAL (lb/yr)	86,430	43		12,964	6
Total lbs/day	237			36	

237 lbs /day total emissions to control with vapor phase carbon

lbs carbon per day = lbs xylene per day x (1/carbon adosrptive capacity)

sorption rate # HC/#

40% carbon Source: Donna Cummings, General Carbon Coroporation

592 lbs carbon/day

5000 lbs of carbon per vessel

Note: One vessel is used because carbon changes will be scheduled when breakthrough of lead carbon vessels is detected. The configuration has 2

1 number of vessels vessels in series

Total lbs of carbon = lbs of carob per vessel x number of vessels

5000 Total lbs of carbon

Days before Changeout = total lbs of carbon / lbs carbon per day

8 Days

Assumptions:
Xylenes represent the average chemical properties of Kiniksu-1

Conclusion:
The lead carbon vessel can operate for 8 days before breakthrough.

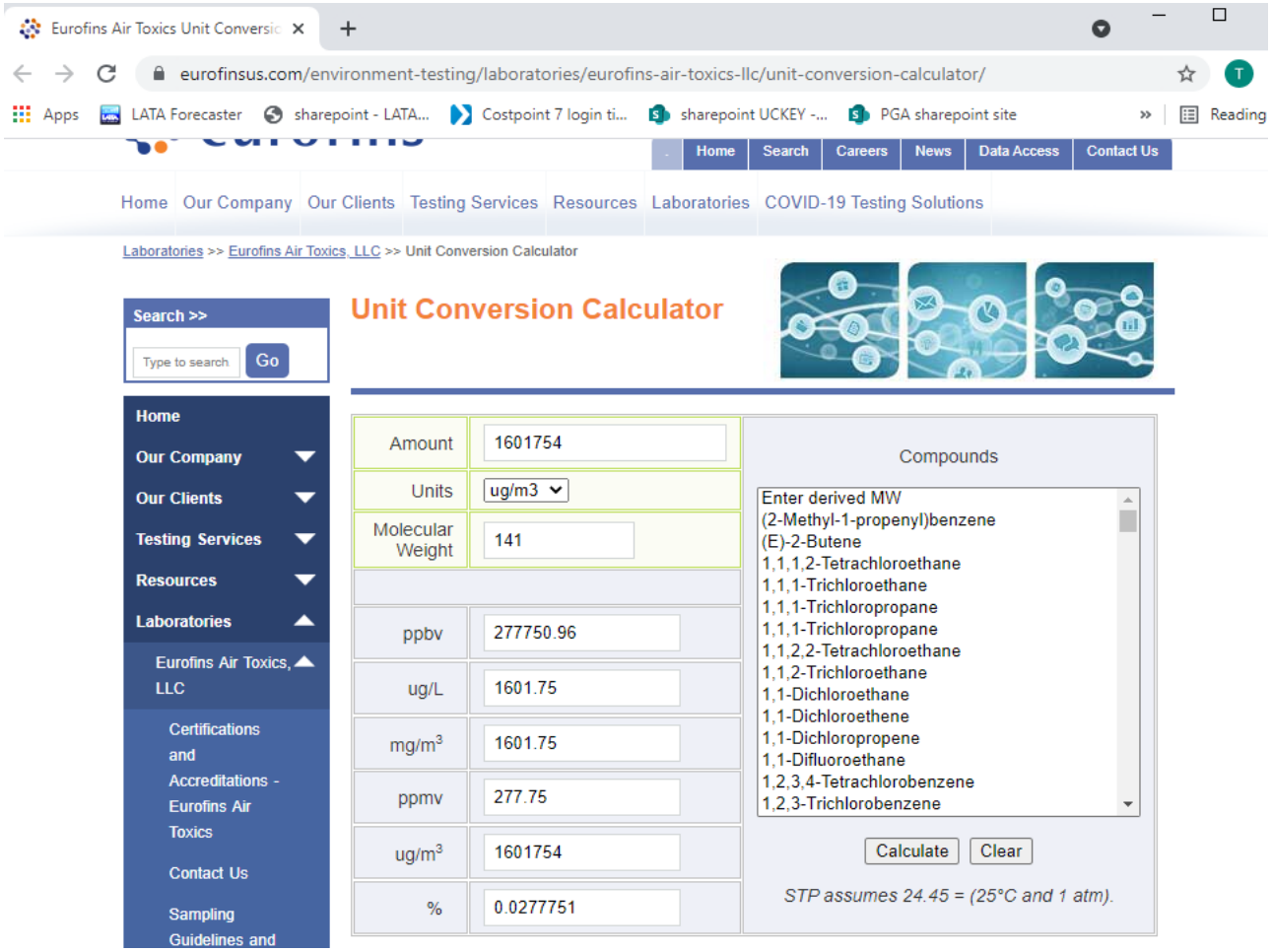
Calculate Inlet VOC Concentration to Blower

Input
Output

237	lb		min		day	4.5E+08	ug	35.000	ft3	1,456,194	ug	equal to 278 ppmv
	day	1794	ft3	1440	min		lb		m3		m3	

Conclusion:
The inlet VOC concentration to the blower is 280 ppmv.

Eurofins Air Toxics Unit Conversion Calculator - Eurofins USA
assuming 141 MW from air permit calculations



Calculate Flow through Carbon Bed based on Superficial Velocity

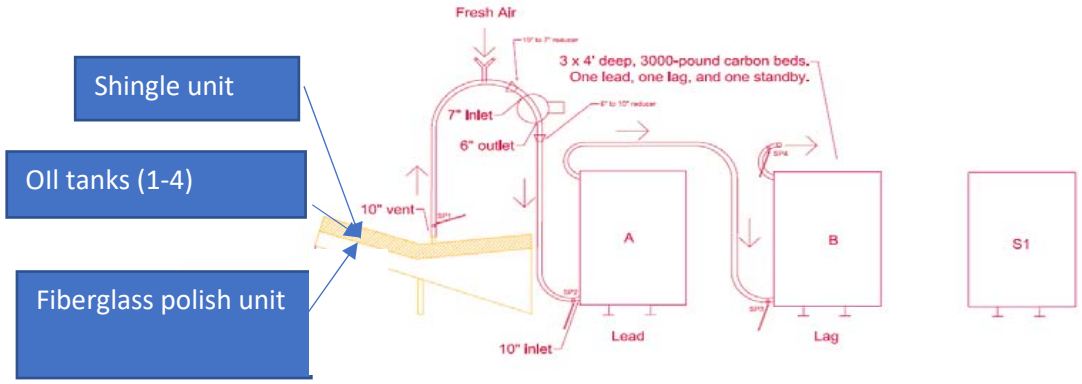
Input
Output

V= Q/A

L	carbon bed Length	6	ft		source: General Carbon Corporation Vapor Box Adsorbers Technical Data Sheet (VB-5000)
W	carbon bed width	8	ft		
A	Area	48	ft^2	**A = L x W**	
Q	Flow	1800	cfm		See air flow calculations
	Bed velocity	38	cfm		within acceptable range of 30-70 fpm

Constraint:
Maintain superficial velocity of 30-70 fpm per 9/21/20 email from Donna Cummings, General Carbon Corporation

Design Assumptions:
General Carbon Corporation VB-5000 Carbon Beds will be used



A	Lead GAC Unit
B	Lag GAC Unit
S1	Standby GAC Unit

Sample Port Monitoring				
Sample Port	1	2	3*	4
Sequence 1	x	x	x	x
Sequence 2	x	x	x	x
Sequence 3	x	x	x	x
x - Record vapor pressure and VOC concentrations				
* - When SP3 is 10% of SP1 breakthrough occurs and configuration changed to next sequence				

Operating Sequence GAC Vessel Layout			
	Lead	Lag	Standby
1	A	B	S1
2	B	S1	A
3	S1	A	B

Conclusion:
1800 CFM is within range of the superficial velocity range of VB-5000.

Name	Dimensions L x W x H	CFM	Carbon WT.	IN/OUT	Bed Volume FT^3	PSIG	Max Vaccum
VB 1000	4 x 4 x 5'3"	15 – 720	1000	6 inch	36	2	6
VB 2000	4 x 4 x 6'5"	15 – 720	2000	6 inch	72	2	4
VB 3000	4 x 6 x 7'7"	240 - 1500	3000	8 inch	108	1	2
VB 5000	6 x 8 x 7'10"	480 - 3000	5000	10 inch	180	1	1
VB 10000	8 x 10 x 9	800 - 5000	10000	12 inch	360	1	NR
VB 20000	8 x 20 x 9'4"	1600 - 10000	20000	18 inch	720	1	NR
VB 40000	8 x 40 x 9'4"	3200 - 20000	40000	18 inch	1440	1	NR

Duct Work and Blower Sizing

Input
Output

Source: See attached Howden Data Sheet
Operating Point:
1800 Volume (cfm)
10 Pressure (" wg)

Howden American Fan Company

Combination Data Sheet
BCS - Backward Curved

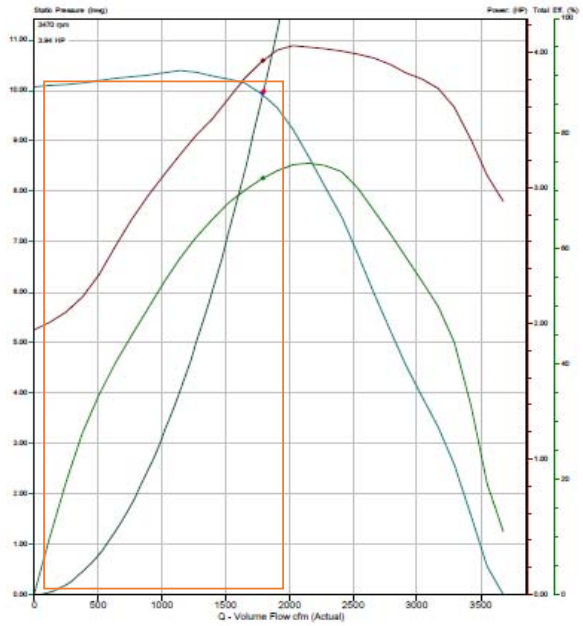
Howden

Quotation Number	:	Fan Code	: BCS-150
Project Name	:	Customer	: General Carbon
Item Reference:	:	Date:	: Wednesday, September 1, 2021

Conditions Specified	
Volume	1800 cfm
Outlet Pressure	10.00 inwg (static)
Inlet Pressure	0.00 inwg (static)
Density	0.075 lb/ft³
Humidity	50 %
Operating Temperature	70 °F
Construction Temperature	0 - 150 °F Standard
Altitude	0 ft
Arrt	4 (dDirect)

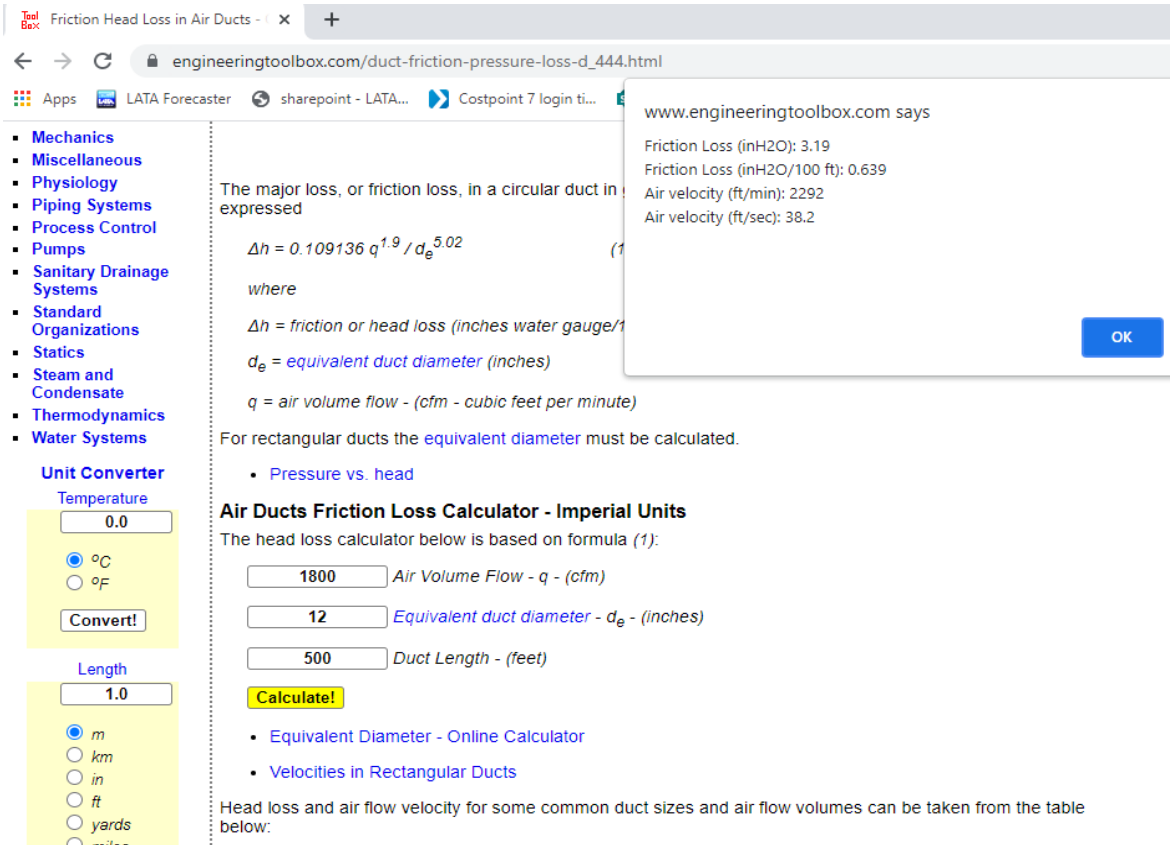
Fan Selection	
Fan Code	BCS-150
Fan Construction	Class 2
Narrow Width	70 %
Volume	1796 cfm
Pressure @ 0.075 lb/ft³	9.96 inwg (static)
Pressure @ 0.075 lb/ft³	10.00 inwg (static)
Power @ 0.075 lb/ft³	3.94 HP
Power @ 0.075 lb/ft³	3.96 HP
Fan Speed	3470 rpm
Max Speed	3973 rpm
Wheel Tip Speed	13627 fpm
Max Safe Tip Speed	15602 fpm
Velocity	1447 fpm
Static Efficiency	71 %

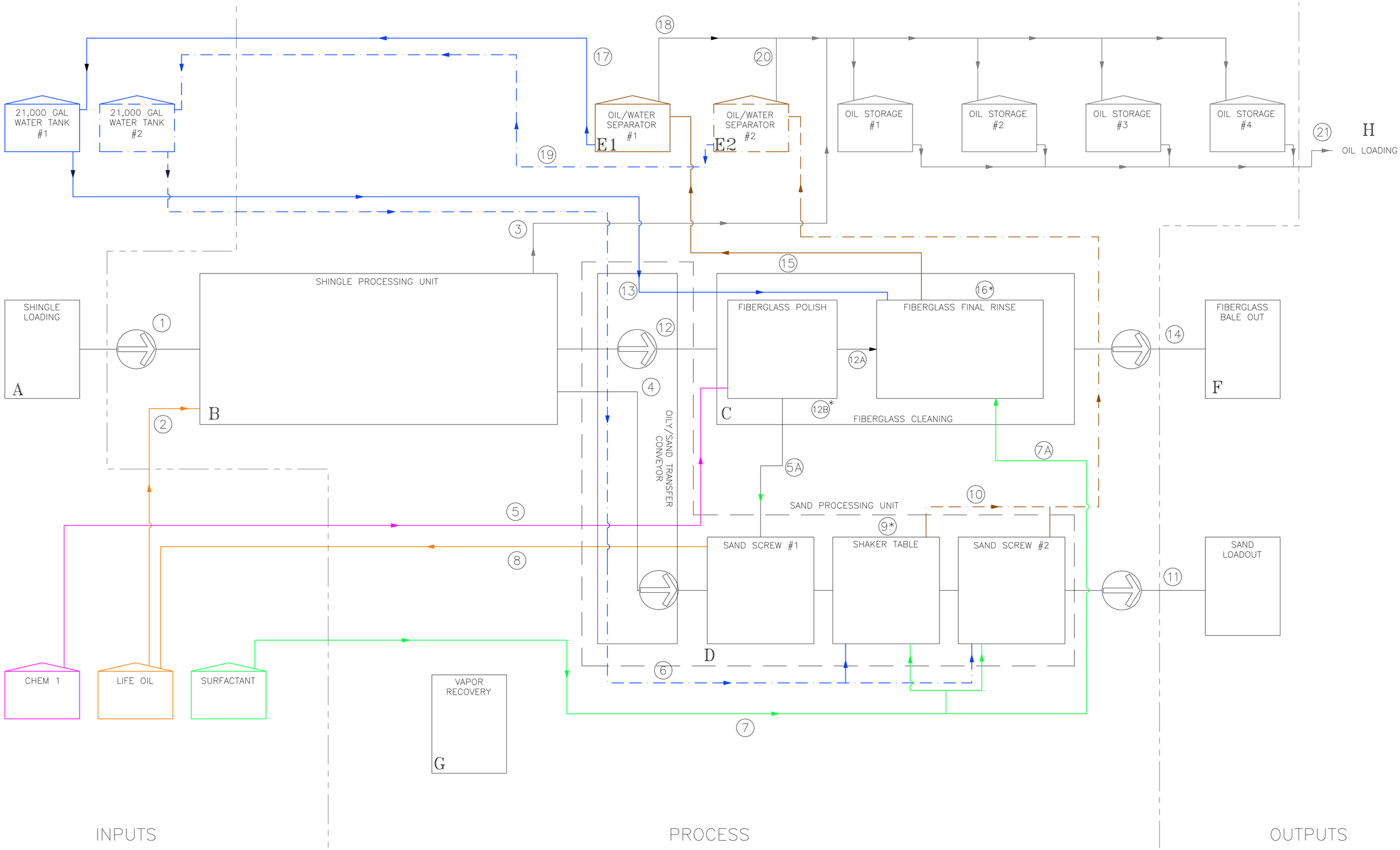
Motor Selection	
Motor Frame	184T
Enclosure	AF Enclosure TEFC
Efficiency Grade	Premium
Speed	3470 rpm
Power	5.00 HP
Full Load	5.96 A
Locked Rotor	53.64 A
Electrical Supply	460 Volts 60 Hz 3 Phase
SFP value	4.40 W/(l/s)
Energy Consumption	7458 kWh (2000 h/year)
Running Cost / Year	$820



	Sound Spectrum (Hz)								Overall	
	63	125	250	500	1k	2k	4k	8k	Lw*	LpA @ 1 m**
Inlet*	94	102	95	94	89	90	86	80	104	86

* Lw dB re 10^{-12} W ** dBA re $2x10^{-5}$ Pa


Friction Head Loss in Air Ducts -
engineeringtoolbox.com/duct-friction-pressure-loss-d_444.html
Apps
LATA Forecaster
sharepoint - LATA...
Costpoint 7 login ti...
www.engineeringtoolbox.com says
Friction Loss (inH2O): 3.19
Friction Loss (inH2O/100 ft): 0.639
Air velocity (ft/min): 2292
Air velocity (ft/sec): 38.2
OK
Mechanics
Miscellaneous
Physiology
Piping Systems
Process Control
Pumps
Sanitary Drainage Systems
Standard Organizations
Statics
Steam and Condensate
Thermodynamics
Water Systems
Unit Converter
Temperature
0.0
°C
°F
Convert!
Length
1.0
m
km
in
ft
yards
The major loss, or friction loss, in a circular duct in
expressed
Δh = 0.109136 q^1.9 / d_e^5.02
where
Δh = friction or head loss (inches water gauge/1
d_e = equivalent duct diameter (inches)
q = air volume flow - (cfm - cubic feet per minute)
For rectangular ducts the equivalent diameter must be calculated.
Pressure vs. head
Air Ducts Friction Loss Calculator - Imperial Units
The head loss calculator below is based on formula (1):
1800
Air Volume Flow - q - (cfm)
12
Equivalent duct diameter - d_e - (inches)
500
Duct Length - (feet)
Calculate!
Equivalent Diameter - Online Calculator
Velocities in Rectangular Ducts
Head loss and air flow velocity for some common duct sizes and air flow volumes can be taken from the table
below:



NOTES:

1. * EVAPORATOR WATER

REV	DATE	DESCRIPTION	DRAWN BY	DRAFT CHK	PROJ ENGR	LEAD ENGR
0	12/21/17	DRAFT DESIGN				

DATE:
PROFESSIONAL SEAL

(614) 508-1200 *(Phone)*
www.lata.com
Los Alamos Technical Associates, Inc.
756 Park Meadow Road
Westerville, OH 43081

C6-ZERO
IOWA
ASPHALT SHINGLE RECYCLING PLANT

PROCESS FLOW DIAGRAM

PROJECT NO.: 11418
CADD DWG FILE: J-1 PFD
CLIENT:

J-1
SHEET 1 OF 3

P:\C6 ZERO\IOWA\DRAFTING-GIS\CADD\07-PROCESS\J-1 PFD.DWG

Certificate of Analysis

SINCE 1985

Quality Controlled Through Analysis

10630 FALLSTONE RD. HOUSTON, TEXAS 77099
P.O. BOX 741905, HOUSTON, TEXAS 77274

TEL: (281) 495-2400
FAX: (281) 495-2410

CLIENT:	C6 Zero	**REQUESTED BY:**	Mr. Howard Brand
CLIENT PROJECT:		**PURCHASE ORDER NO:**	CHECK
LABORATORY NO:	94788-001 Page 1 of 5	**REPORT DATE:**	July 1, 2021
SAMPLE:	C6-Zero Chemical- CDHDRL		

TEST **RESULT**

Organic Composition Breakdown by GC-MS- Calculate Vapor Density, ASTM D 5739.b

The sample was analyzed on a gas chromatography/mass spectrometer. A library search was performed on the collected data using the Wiley 138 Library and the NIST 98 Library. Together, the libraries contain approximately 200,000 compounds.

The sample was analyzed as received on the GC/MS. These data presented are based on the chromatographable components found. If heavier compounds or polymers are present these were not seen on the gas chromatograph/ mass spectrometer. No corrections were made for the presence of any metals or water content on this organic analysis report. The identities and approximate concentrations that follow are based on the best spectral comparisons from our libraries and the total ion relative areas of the peaks observed.

The organic material found in this sample primarily consists of condensate range hydrocarbons We also found N,N-dimethylstearamide, alkylated naphthalene and other low level unidentified compounds.

The approximate relative concentration of the organic chemical types are as follows:

Tentatively Identified Compounds Found	**Relative Concentration Percent by Weight**
Paraffins (C5 – C7)	28.9
Isoparaffins (C5 – C7)	34.1
Naphthenics (C5 – C7)	2.6
Olefins (C5 – C7)	0.7
Alkylated naphthalene	10.6
Indene	0.1
N,N- dimethylstearamide	22.7
2-propanol	0.2
Low level and unidentified compounds	0.1
Total	100.0

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SAMPLE:	C6-Zero Chemical- CDHDRL		

TEST **RESULT**

Parameter	***Results***
Flash Point, Pensky-Martens Closed Cup, ASTM D 93M, °C	-8
Physical Appearance, Visual	Clear & Bright
Volatile Compounds @ 110°C, EPA 24, wt. %	87.73
Water Content by Karl Fischer Method, Lubricating Oils and Additives, ASTM D 6304, ppm	569
Autoignition Temperature of Liquid Chemicals, ASTM E 659, °C	220
Viscosity, Kinematic, at 100ºF, ASTM D 445.a, cSt	0.60
Solubility, Measurements of Aqueous Solubility, @ 25ºC, ASTM E 1148, mg/L	2.2
Vapor Pressure of Liquids by Ebulliometry @ 20ºC, ASTM E 1719, mmHg	39
Color, ASTM Color Scale, ASTM D 1500	0.2
Evaporation Rate of Volatile Liquids, Relative to Butyl Acetate = 1, ASTM D 3539	0.09
Vapor Pressure by Ebulliometry,10 % Driftwood shingle :90% by wt, @ 20ºC, ASTM D 1719, mmHg	35
Vapor Pressure by Ebulliometry,10 % Dessert Tan shingle :90% by wt, @ 20ºC, ASTM D 1719, mmHg	35

Flammability of Chemicals, Upper and Lower Limits, ASTM E 681

	Results, vol. %
LFL, @25ºC, @760mmHg	0.8
UFL, @25ºC, @760mmHg	6.5

Odor of Volatile Solvents and Diluents, ASTM D 1296

	Results
Odor	Characteristic

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LABORATORY NO:	94788-001 Page 3 of 5	**REPORT DATE:**	July 1, 2021
SAMPLE:	C6-Zero Chemical- CDHDRL		

TEST **RESULT**

Purgeable Organic Compounds in Water by Capillary Column GC-MS. ASTM D 5790

	Results, mg/Kg
Dichlorodifluoromethane	<100
Chloromethane	<100
Vinyl chloride	<100
Bromomethane	<100
Chloroethane	<100
Trichlorofluoromethane	<100
Methyl Ethyl Ketone	<100
2-Propanone	<100
1,1-Dichloroethene	<100
Methylene chloride	<100
trans-1,2-Dichloroethene	<100
1,1-Dichloroethane	<100
cis-1,2-Dichloroethene	<100
2,2-Dichloropropane	<100
Bromochloromethane	<100
Chloroform	<100
1,1,1-Trichloroethane	<100
1,2-Dichloroethane	<100
1,1-Dichloropropene	<100
Benzene	<100
Carbontetrachloride	<100
1,2-Dichloropropane	<100
Trichloroethene	<100
Dibromomethane	<100
Bromodichloromethane	<100
Cis-1,3-Dichloropropene	<100
Trans-1,3-Dichloropropene	<100
Toluene	<100
1,1,2-Trichloroethane	<100
1,3-Dichloropropane	<100
Dibromochloromethane	<100
1,2-Dibromoethane	<100
Tetrachloroethene	<100
Chlorobenzene	<100
1,1,1,2-Tetrachloroethane	<100

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SAMPLE:	C6-Zero Chemical- CDHDRL		

TEST **RESULT**

Purgeable Organic Compounds in Water by Capillary Column GC-MS. ASTM D 5790

	Results, mg/Kg
Ethylbenzene	<100
Bromoform	<100
Styrene	<100
o-Xylene	<100
1,1,2,2-Tetrachloroethane	<100
1,2,3-Trichloropropane	<100
isopropylbenzene	<100
Bromobenzene	<100
2-Chlorotoluene	<100
n-Propylbenzene	<100
4-Chlorotoluene	<100
1,3,5-Trimethylbenzene	<100
tert-Butylbenzene	<100
1,2,4-Trimethylbenzene	<100
1,3-Dichlorobenzene	<100
sec-Butylbenzene	<100
1,4-Dichlorobenzene	<100
p-Isopropyltoluene	<100
1,2-Dichlorobenzene	<100
n-Butylbenzene	<100
1,2-Dibromo-3-chloropropane	<100
1,2,4-Trichlorobenzene	<100
Naphthalene	<100
1,2,3-Trichlorobenzene	<100
Hexachlorobutadiene	<100

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TEST **RESULT**

Boiling Point of Petroleum Products at Atmospheric Pressure. ASTM D 86.a

	Results
Initial Boiling Point, °F	160
5% recovered, °F	192
10% recovered, °F	198
15% recovered, °F	200
20% recovered, °F	202
30% recovered, °F	203
40% recovered, °F	204
50% recovered, °F	205
60% recovered, °F	206
70% recovered, °F	209
80% recovered, °F	214
90% recovered, °F	530
97% recovered, °F	561
End Point, °F	561
Percent Recovery, %	97
Percent Residue, %	3
Percent Lost, %	0

Spcific Gravity of Liquids by Digital Density Meter. ASTM D 4052

	Results
Density @20ºC, g/cm³	0.7286
API Gravity @ 60ºF	61.45

Respectfully submitted
For Texas OilTech Laboratories, L.P.

Mr. Ikenna "Ike" Ezeji
Laboratory Director

Certificate of Analysis

SINCE 1985

Quality Controlled Through Analysis

10630 FALLSTONE RD. HOUSTON, TEXAS 77099
P.O. BOX 741905, HOUSTON, TEXAS 77274

TEL: (281) 495-2400
FAX: (281) 495-2410

CLIENT:	C6 Zero	**REQUESTED BY:**	Mr. Howard Brand
CLIENT PROJECT:		**PURCHASE ORDER NO:**	CHECK
LABORATORY NO:	94788-002 Page 1 of 4	**REPORT DATE:**	July 1, 2021
SAMPLE:	C6-Zero Production Fuel		

TEST **RESULT**

Boiling Range Distribution of Petroleum Fraction by Gas Chromatography, ASTM D 2887*

	Results, °F
Initial Boiling Point	156
5% recovered	162
10% recovered	169
15% recovered	176
20% recovered	182
25% recovered	189
30% recovered	196
35% recovered	203
40% recovered	210
45% recovered	216
50% recovered	222
55% recovered	228
60% recovered	234
65% recovered	241
70% recovered	247
75% recovered	253
80% recovered	458
85% recovered	500
90% recovered	556
95% recovered	574
100% recovered	1015

Note: The sample was not compatible with ASTM D 7169 due to volatility.

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SAMPLE:	C6-Zero Production Fuel		

TEST **RESULT**

Parameter	***Results***
Physical Appearance, Visual	Dark in appearance
Volatile Compounds @ 110°C, EPA 24, wt. %	50.58
Water Content by Karl Fischer Method, Lubricating Oils and Additives, ASTM D 6304, ppm	1,095
Autoignition Temperature of Liquid Chemicals, ASTM E 659, °C	285
Solubility, Measurements of Aqueous Solubility, @ 25ºC, ASTM E 1148, mg/L	1.9
Vapor Pressure of Liquids by Ebulliometry @ 20ºC, ASTM E 1719, mmHg	35
Color, ASTM Color Scale, ASTM D 1500	>8.0
Evaporation Rate of Volatile Liquids, Relative to Butyl Acetate = 1, ASTM D 3539	0.03
Flash Point, Pensky-Martens Closed Cup, ASTM D 93M, °C	-19*
Viscosity, Cone/Plate, Rheometer, Shear Rate 50 s^{-1}, @ 100ºF, ASTM D 4287, mPa·s	44.44
Specific Gravity by Helium Pycnometer Method @ 25ºC, ASTM D 4892, g/cm³	0.822
Vapor Density Calculation, In-House @ 25ºC	3.4

*Substituted for ASTM D 1310 due to the nature of the sample.

Odor of Volatile Solvents and Diluents, ASTM D 1296

	Results
Odor	Characteristic

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LABORATORY NO:	94788-002 Page 3 of 4	**REPORT DATE:**	July 1, 2021
SAMPLE:	C6-Zero Production Fuel		

TEST **RESULT**

Purgeable Organic Compounds in Water by Capillary Column GC-MS. ASTM D 5790

	Results, mg/Kg
Dichlorodifluoromethane	<100
Chloromethane	<100
Vinyl chloride	<100
Bromomethane	<100
Chloroethane	<100
Trichlorofluoromethane	<100
Methyl Ethyl Ketone	<100
2-Propanone	<100
1,1-Dichloroethene	<100
Methylene chloride	<100
trans-1,2-Dichloroethene	<100
1,1-Dichloroethane	<100
cis-1,2-Dichloroethene	<100
2,2-Dichloropropane	<100
Bromochloromethane	<100
Chloroform	<100
1,1,1-Trichloroethane	<100
1,2-Dichloroethane	<100
1,1-Dichloropropene	<100
Benzene	<100
Carbontetrachloride	<100
1,2-Dichloropropane	<100
Trichloroethene	<100
Dibromomethane	<100
Bromodichloromethane	<100
Cis-1,3-Dichloropropene	<100
Trans-1,3-Dichloropropene	<100
Toluene	<100
1,1,2-Trichloroethane	<100
1,3-Dichloropropane	<100
Dibromochloromethane	<100
1,2-Dibromoethane	<100
Tetrachloroethene	<100
Chlorobenzene	<100
1,1,1,2-Tetrachloroethane	<100

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CLIENT PROJECT:		**PURCHASE ORDER NO:**	CHECK
LABORATORY NO:	94788-002 Page 4 of 4	**REPORT DATE:**	July 1, 2021
SAMPLE:	C6-Zero Production Fuel		

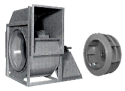
TEST **RESULT**

Purgeable Organic Compounds in Water by Capillary Column GC-MS. ASTM D 5790

	Results, mg/Kg
Ethylbenzene	<100
Bromoform	<100
Styrene	<100
o-Xylene	<100
1,1,2,2-Tetrachloroethane	<100
1,2,3-Trichloropropane	<100
isopropylbenzene	<100
Bromobenzene	<100
2-Chlorotoluene	<100
n-Propylbenzene	<100
4-Chlorotoluene	<100
1,3,5-Trimethylbenzene	<100
tert-Butylbenzene	<100
1,2,4-Trimethylbenzene	<100
1,3-Dichlorobenzene	<100
sec-Butylbenzene	<100
1,4-Dichlorobenzene	<100
p-Isopropyltoluene	<100
1,2-Dichlorobenzene	<100
n-Butylbenzene	<100
1,2-Dibromo-3-chloropropane	<100
1,2,4-Trichlorobenzene	<100
Naphthalene	<100
1,2,3-Trichlorobenzene	<100
Hexachlorobutadiene	<100

Respectfully submitted
For Texas OilTech Laboratories, L.P.

Mr. Ikenna "Ike" Ezeji
Laboratory Director



Howden American Fan Company
Technical Data Sheet
BCS - Backward Curved

Quotation Number	:	Fan Code	: BCS-150
Project Name	:	Customer	: General Carbon
Item Reference:	:	Date:	: Wednesday, September 1, 2021

Conditions Specified

Volume	1800 cfm
Outlet Pressure	10.00 inwg (static)
Inlet Pressure	0.00 inwg (static)
Density	0.075 lb/ft³
Humidity	50 %
Operating Temperature	70 °F
Construction Temperature	0 - 150 °F Standard
Altitude	0 ft
Arrt	4 (dDirect)

Fan Selection

Fan Code	BCS-150
Fan Construction	Class 2
Narrow Width	70 %
Volume	1796 cfm
Pressure @ 0.075 lb/ft³	9.96 inwg (static)
Pressure @ 0.075 lb/ft³	10.00 inwg (static)
Power @ 0.075 lb/ft³	3.94 HP
Power @ 0.075 lb/ft³	3.96 HP
Fan Speed	3470 rpm
Max Speed	3973 rpm
Wheel Tip Speed	13627 fpm
Max Safe Tip Speed	15602 fpm
Velocity	1447 fpm
Static Efficiency	71 %

Motor Selection

Motor Frame	184T
Enclosure	AF Enclosure TEFC
Efficiency Grade	Premium
Speed	3470 rpm
Power	5.00 HP
Full Load	5.96 A
Locked Rotor	53.64 A
Electrical Supply	460 Volts 60 Hz 3 Phase
SFP value	4.40 W/(l/s)
Energy Consumption	7458 kWh (2000 h/year)
Running Cost / Year	$820

Terms and Conditions:This offer is made subject to the terms and conditions detailed on the accompanying letter.

	Sound Spectrum (Hz)								Overall	
	63	125	250	500	1k	2k	4k	8k	Lw*	LpA @ 1 m**
Inlet*	94	102	95	94	89	90	86	80	104	86

* Lw dB re 10^{-12} W ** dBA re $2x10^{-5}$ Pa

Description	Qty	Unit Price	Price
Fan			
BCS-150	1	Consult Factory	Consult Factory
Fan Accessories			
TOTAL PRICE FAN AND ACCESSORIES (ex WORKS)			Consult Factory

231 Greenwood Ave
Ste A, Midland Park, NJ, 07432
Tel: 201 888 8622 Fax:
Website:
Email: ewilts@myfairpoint.net

Howden American Fan Company
Combination Data Sheet
BCS - Backward Curved

Quotation Number	:	Fan Code	: BCS-150
Project Name	:	Customer	: General Carbon
Item Reference:	:	Date:	: Wednesday, September 1, 2021

Conditions Specified

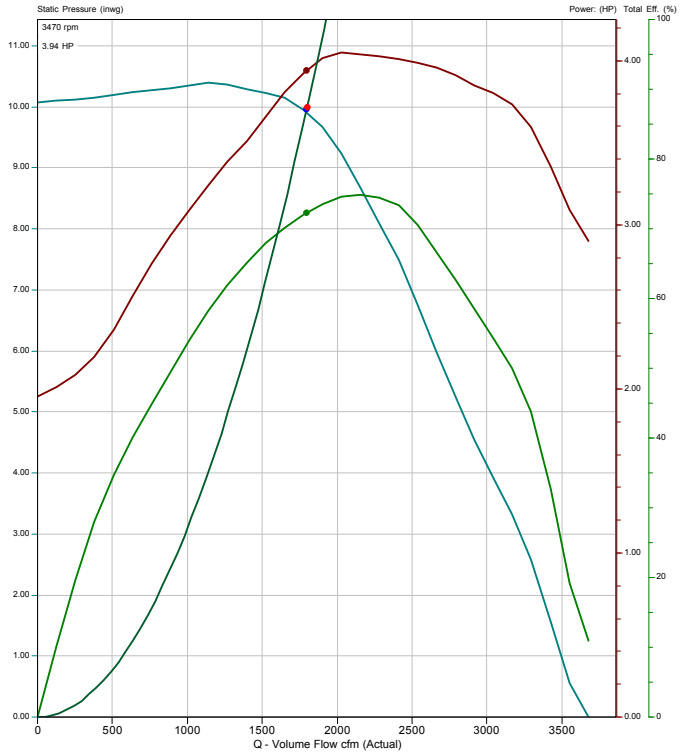
Volume	1800 cfm
Outlet Pressure	10.00 inwg (static)
Inlet Pressure	0.00 inwg (static)
Density	0.075 lb/ft³
Humidity	50 %
Operating Temperature	70 °F
Construction Temperature	0 - 150 °F Standard
Altitude	0 ft
Arrt	4 (dDirect)

Fan Selection

Fan Code	BCS-150
Fan Construction	Class 2
Narrow Width	70 %
Volume	1796 cfm
Pressure @ 0.075 lb/ft³	9.96 inwg (static)
Pressure @ 0.075 lb/ft³	10.00 inwg (static)
Power @ 0.075 lb/ft³	3.94 HP
Power @ 0.075 lb/ft³	3.96 HP
Fan Speed	3470 rpm
Max Speed	3973 rpm
Wheel Tip Speed	13627 fpm
Max Safe Tip Speed	15602 fpm
Velocity	1447 fpm
Static Efficiency	71 %

Motor Selection

Motor Frame	184T
Enclosure	AF Enclosure TEFC
Efficiency Grade	Premium
Speed	3470 rpm
Power	5.00 HP
Full Load	5.96 A
Locked Rotor	53.64 A
Electrical Supply	460 Volts 60 Hz 3 Phase
SFP value	4.40 W/(l/s)
Energy Consumption	7458 kWh (2000 h/year)
Running Cost / Year	$820



	Sound Spectrum (Hz)								Overall	
	63	125	250	500	1k	2k	4k	8k	Lw*	LpA @ 1 m**
Inlet*	94	102	95	94	89	90	86	80	104	86

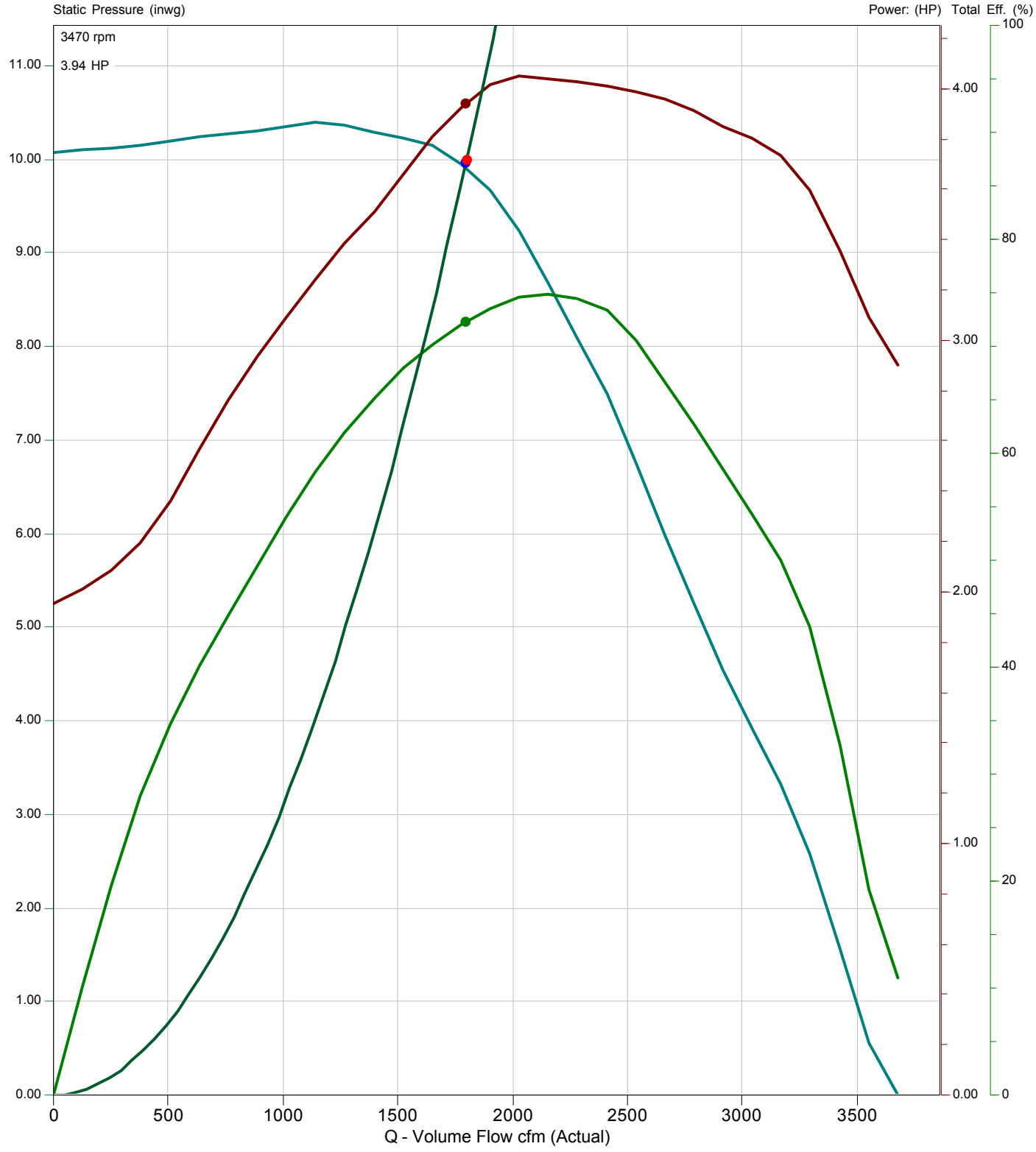
* Lw dB re 10^{-12} W ** dBA re $2x10^{-5}$ Pa

Terms and Conditions: This offer is made subject to the terms and conditions detailed on the accompanying letter.

Description	Qty	Unit Price	Price
Fan BCS-150 Fan Accessories	1	Consult Factory	Consult Factory
		TOTAL PRICE FAN AND ACCESSORIES (ex WORKS)	Consult Factory

231 Greenwood Ave
Ste A, Midland Park, NJ, 07432
Tel: 201 888 8622 Fax:
Website:
Email: ewilts@myfairpoint.net

Quotation Number	:	Fan Code	: BCS-150
Project Name	:	Customer	: General Carbon
Item Reference:	:	Date:	: Wednesday, September 1, 2021



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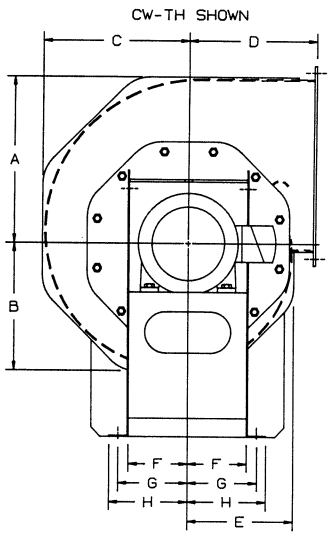
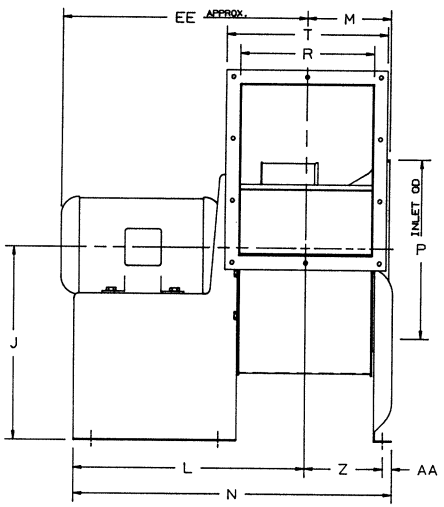
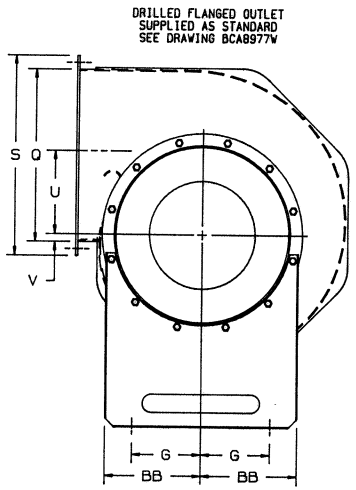
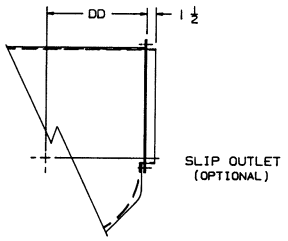
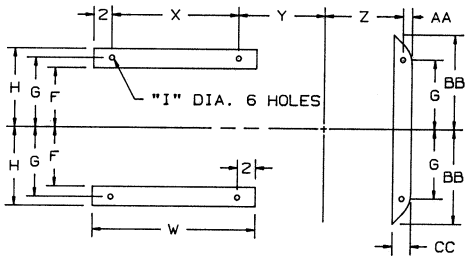










FOUNDATION PLAN

APPROXIMATE MOTOR WEIGHT

FRAME SIZES	WEIGHT LBS.
143T	45
145T	52
182T	85
184T	100
213T	150
215T	170
254T	260
256T	290

APPROX. FAN WEIGHTS LESS MOTOR

FAN SIZE	143/145T CLASS 1 & 2	143/145T CLASS 3 & 4	182/184T CLASS 1 & 2	182/184T CLASS 3 & 4	213/215T CLASS 1 & 2	213/215T CLASS 3 & 4	254/256T CLASS 1 & 2	254/256T CLASS 3 & 4
122	103	126	102	125	101	124		
135	115	141	114	140	113	139	—	—
150	133	161	132	160	131	159		
165	208	252	206	250	205	249	203	247
182	235	281	233	279	232	278	231	277
200	264	328	262	326	261	325	259	323

FAN SIZE	WHEEL DIA.	A	B	C	D	E	F	G	H	I	J	L	M	N	P	Q	R	S	T	U	V	W	X	Y	Z	AA	BB	CC	DD	EE 143T	EE 145T	EE 182T	EE 184T	EE 213T	EE 215T	EE 254T	EE 256T
122	12 1/4	12 3/8	9 3/8	10 7/8	10	7 7/8	5 1/2	6 3/8	7 1/8	7/16	15	17 17/32	5 31/32	23 3/4	13 3/8	12 5/16	8 13/16	15 5/16	11 13/16	5 31/32	3/16	13	9	6 17/32	5 15/32	3/4	9 3/4	1 5/8	8 5/16	14 11/32	14 27/32	16 5/32	16 21/32	19 1/32	19 27/32		
135	13 1/2	13 9/16	10 5/16	11 15/16	11	8 11/16	5 1/2	6 3/8	7 1/8	7/16	16	17 15/16	6 3/8	24 9/16	14 3/8	13 9/16	9 5/8	16 9/16	12 5/8	6 9/16	7/32	13	9	6 15/16	5 7/8	3/4	9 3/4	1 5/8	9 5/16	14 23/32	15 9/32	16 19/32	17 3/32	19 15/32	20 9/32	—	—
150	15	15 1/16	11 7/16	13 1/4	12	9 5/8	5 1/2	6 3/8	7 1/8	7/16	18	18 1/2	6 15/16	25 3/4	16 1/2	15 1/8	10 3/4	18 1/8	13 3/4	7 9/32	9/32	13	9	7 1/2	6 1/2	3/4	9 3/4	1 5/8	10 5/16	15 9/32	15 27/32	17 5/32	17 21/32	20 1/32	20 27/32		
165	16 1/2	16 9/16	12 9/16	14 9/16	13	10 9/16	6 1/2	7 5/8	8 5/8	9/16	19	23 1/32	7 15/32	31 5/16	17 1/2	16 5/8	11 13/16	19 5/8	14 13/16	7 31/32	11/32	17	13	8 1/32	7 9/32	1	11 1/2	2 1/8	11 1/4	15 27/32	16 13/32	17 23/32	18 7/32	20 19/32	21 13/32	24 27/32	25 23/32
182	18 1/4	18 1/4	13 13/16	16 1/16	14	11 5/8	6 1/2	7 5/8	8 5/8	9/16	21	23 5/8	8 1/2	32 9/16	19 1/2	18 3/8	13	21 3/8	16	8 27/32	11/32	17	13	8 5/8	7 15/16	1	11 1/2	2 1/8	12 1/4	16 7/16	17	18 5/16	18 13/16	21 3/16	22	25 7/16	26 5/16
200	20	20	15 1/8	17 9/16	15	12 11/16	6 1/2	7 5/8	8 5/8	9/16	22	24 7/32	8 23/32	33 3/4	21 1/2	20 1/8	14 3/16	23 1/8	17 3/16	9 11/16	3/8	17	13	9 7/32	8 17/32	1	12 3/8	2 1/8	13 1/4	17 1/32	17 19/32	18 29/32	19 13/32	21 25/32	22 19/32	27	26 29/32

ROTATION VIEWED FROM DRIVE SIDE

NOTE: OUTLET FLANGE NOT SUPPLIED ON DB DISCHARGE *

CW TH — FIG. 1
CW TAU — FIG. 2
CW UB — FIG. 3
CW BAU — FIG. 4
CW BH — FIG. 5
CW DB — FIG. 6*
CW TAD — FIG. 7
CCW TH — FIG. 8
CCW TAU — FIG. 9
CCW UB — FIG. 10
CCW BAU — FIG. 11
CCW BH — FIG. 12
CCW DB — FIG. 13*
CCW TAD — FIG. 14

70% WIDTH

REFERENCE DWG NO	TITLE	JOB NO.

TITLE: BCA/BCS - 122 THRU 200 ARR'T 4 70% WIDTH

DATE: 7/9/90

DRAWING NO: BCC1601F

REVISION RECORD:

SCALE: NONE

DRAWN BY: TES

CHECKED BY:

APPROVED BY:

DATE	DRWN BY	APPR. BY	REVISION RECORD	NO.

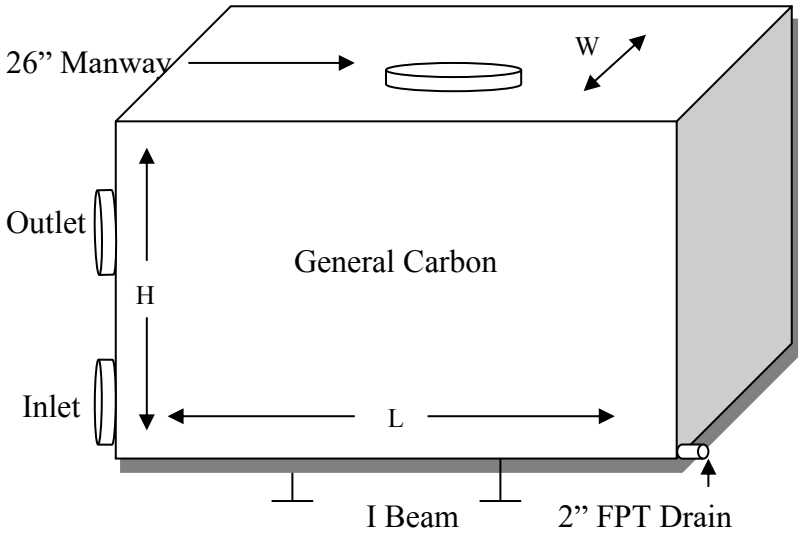
Howden Howden American Fan

AMERICAN FAN COMPANY
2933 Symmes Road, Fairfield, Ohio 45014
Phone: (513) 874-2400 Telefax: (513) 870-6577

546832

VAPOR BOX ADSORBERS

General Carbon's Vapor Box series of carbon adsorbers are versatile high airflow units. Each filter is easily transportable via the "I" beams support structure or lifting lugs. The large bed surface area in each model allows for the treatment of higher airflow rates. The Vapor Box adsorbers are constructed of mild steel and have two part epoxy coatings on the inside and industrial enamel on the outside to provide long service life. They are equipped with a manhole large enough for easy carbon change-outs. Several different grades of virgin and reactivated carbon are available to satisfy your unique filtration requirements.



*The Vapor Boxes are also available in stainless steel *

Name	Dimensions L x W x H	CFM	Carbon WT.	IN/OUT	Bed Volume FT^3	PSIG	Max Vaccum
VB 1000	4 x 4 x 5'3"	15 – 720	1000	6 inch	36	2	6
VB 2000	4 x 4 x 6'5"	15 – 720	2000	6 inch	72	2	4
VB 3000	4 x 6 x 7'7"	240 - 1500	3000	8 inch	108	1	2
VB 5000	6 x 8 x 7'10"	480 - 3000	5000	10 inch	180	1	1
VB 10000	8 x 10 x 9	800 - 5000	10000	12 inch	360	1	NR
VB 20000	8 x 20 x 9'4"	1600 - 10000	20000	18 inch	720	1	NR
VB 40000	8 x 40 x 9'4"	3200 - 20000	40000	18 inch	1440	1	NR

33 Paterson Street Paterson, NJ 07501 Tel: 973-523-2223 Fax: 973-523-1494
www.generalcarbon.com sales@generalcarbon.com

Installation & Start-up – The Vapor Box adsorbers require no special procedure for start up. Remove the shipping covers from the inlet and outlet and make the proper connections to your system. The unit is now ready for service and can be started up. Unions or quick-disconnect fittings are recommended if the unit will be disconnected frequently. Multiple units are usually connected in series with testing advised between the units to determine when the first unit needs to be changed-out.

Maintenance – When in use, the Vapor Box requires no maintenance other than the monitoring of the influent and effluent liquid streams and the operating pressure of the system. Monitoring the air stream into the last unit in a series arrangement is a recommended safeguard against breakthrough in the final outflow. When the concentration of contaminants in the outflow equals the concentration in the inflow, the Vapor Box has reached its removal capacity and should be removed from service. The working life of each adsorber is dependent upon the type of contaminant in the water as well as its concentration and the air flow rate. A pressure relief device is advised to prevent damage to the canister in the event of excessive pressure buildup.

Recharging the General – Once the carbon is saturated by contaminants, the unit should be removed and replaced with a fresh one. To purchase replacement carbon or to arrange for a carbon change-out, please contact our office.

Disposal – Dispose of the spent carbon in accordance with Federal, State and Local regulations.

WARNING!

Wet activated carbon removes oxygen from air causing a severe hazard to workers inside carbon vessels. Confined space/low oxygen procedures should be put in place before any entry is made. Such procedures should comply with all applicable local, State and Federal guidelines.

33 Paterson Street Paterson, NJ 07501 Tel: 973-523-2223 Fax: 973-523-1494
www.generalcarbon.com sales@generalcarbon.com

Leaders in Project Excellence

Internal Memorandum

To: Todd Struttmann

From: Cory Tackett

Subject: Control and Operations Sequence for Air Pollution Control Equipment

Date: September 2, 2021

Below is a description of the vapor phase carbon system control scheme per attached Figure 1.

Vapor phase emissions will be vacuumed from the shingle processing unit, fiberglass polishing unit and the oil storage tanks (4). using a nominal 1,800 standard cubic feet per minute (SCFM) blower and will convey through a granulated activated carbon (GAC) treatment system. The GAC system will include three 5,000-pound (lbs) GAC vessels.

Vacuum pressure at all sample ports will be recorded at the beginning of each shift using a manometer. VOCs will also be monitored at the inlet and outlet of both online vessels using a photoionization detector (PID). The PID will be connected to a supervisory control and data acquisition system (SCADA) whose warning system will be programmed to send a warning when sample port 3 (SP3) detects VOC concentrations. Additional warnings will be set off when concentrations at SP3 are 10% of SP1 and when VOC concentrations are detected at SP4. An automatic system shutdown will occur when SP4 detects VOC concentrations at 40 ppm (37 lbs/day of VOCs).

When the outlet detection is 10% of the inlet detection (90% removal efficiency), the vessel is considered loaded. When 10% outlet emissions are noted, vessel A will be taken offline, vessel B will become the lead, and the standby vessel (S1) will become the lag vessel (sequence B as seen on Figure 1).

Safeguards will be in place to ensure compliance with the facility air permit exemption. The first is having the standby GAC vessel. Having three vessels onsite allow production to continue when the lead vessel experience breakthrough. As seen on Figure 1, sequence 1 will run upon start up. When the concentration at SP3 is 10% of the concentration at SP1, breakthrough has occurred, and configuration is changed to the next sequence.

A second safeguard is monitoring the inlet and outlet of the two online GAC vessels with a PID. It is important to note that the PID selected must be able to detect VOCs between 1 ppm and 1,000 ppm. This allows the emissions to be monitored within the carbon system and to calculate the actual bed loading and mass removal. This monitoring allows carbon changeouts to be scheduled based on known break through, avoiding unnecessary carbon changeouts while maintaining air permit compliance. A PID connected to a SCADA system will allow the system to monitor VOC concentrations at all ports and send automatic alarm when breakthrough has occurred. The PID and SCADA system also allow for an automatic system shutdown point to be established to ensure air permit compliance.

Draft Operating Procedure

At the beginning of each shift, the below will occur:

- Sample port 1 (SP1) will be utilized to measure the vacuum pressure of the inlet of the shingle processing unit using a manometer.
- Sample port 2 (SP2) will be utilized to measure the vacuum pressure at the inlet of the lead GAC vessel after dilution utilizing a manometer.
- Sample port 3 (SP3) will be utilized to measure the vacuum pressure at the outlet of the lead vessel/inlet of the lag vessel. A manometer will be used to collect the vacuum pressure.
- Using a manometer, sample port 4 (SP4) will be utilized to measure the vacuum pressure at the outlet of the lag vessel The SCADA will be checked for alarms and if needed a carbon changeout will be scheduled.
- The technician will record the vacuum pressure readings and review the PID readings to ensure compliance.

When the outlet concentrations are 10% of the inlet concentrations, breakthrough of the lead vessel has occurred meaning the below will be done:

- The lead vessel will go offline.
- The lag vessel will be set as the lead vessel.
- The standby vessel will be set as the lag vessel.
- A carbon changeout will be scheduled for the impregnated lead vessel and the current lead/former lag vessel

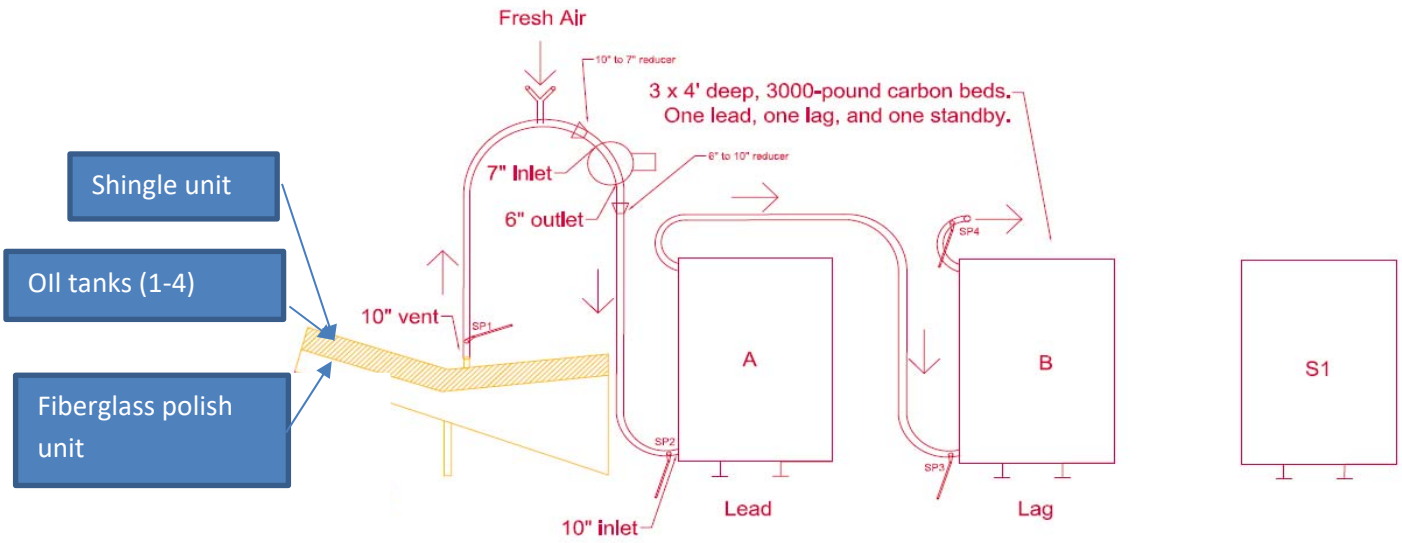
System Control Components

System interlocks include:

- The system will shut down if the VOC concentrations at SP4 reach 40 ppm (37 lbs/day of VOCs) which is the permit limit averaged over a year.

Alarming to include:

- Breakthrough of the lead carbon vessel. When the VOC concentrations at the outlet of the lead vessel are 10% of the inlet VOC concentrations, a warning will be tripped indicating breakthrough.
- Breakthrough of the lag carbon vessel. When the VOC concentrations at the outlet of the lag vessel are 40 ppm (37 lbs/day), the post-control emission rates, averaged over a year, the system will automatically be shut down.



Sample Port Monitoring				
Sample Port	1	2	3*	4
Sequence 1	x	x	x	x
Sequence 2	x	x	x	x
Sequence 3	x	x	x	x
x - Record vapor pressure and VOC concentrations				
* - When SP3 is 10% of SP1 breakthrough occurs and configuration changed to next sequence				

Operating Sequence GAC Vessel Layout			
	Lead	Lag	Standby
1	A	B	S1
2	B	S1	A
3	S1	A	B